

Spacer **52** can be connected to seed **10** by any means known. For example, spacer **52** can be connected to seed **10** by direct attachment such as by gluing, crimping, or melting. Spacer **52** can be attached to any portion of the seed **10**. For rod or cylinder-shaped seeds **10**, to facilitate implantation, it is generally preferred that spacer **52** be attached to the ends of the seeds **10** that the ends would be adjacent to one another when the chain **50** is inserted into the barrel of a brachytherapy implantation needle. Spacer **52** and seed **10**, however, need not be physically attached to each other. Rather they can also be associated with each other by placing each with within the lumen of a tube. The tube can be used to load a brachytherapy seed implantation device with a plurality of spacers **52** and seeds **10** in any sequence. For example, the brachytherapy seed implantation device can be loaded with one (or 2, 3, 4, 5, or more) spacer **52** being interposed between every two seeds **10**. Similarly, the brachytherapy seed implantation device can be loaded with one (or 2, 3, 4, 5, or more) seed **10** being interposed between every two spacers **52**.

Methods of Making Brachytherapy Seeds

Brachytherapy seeds of the invention can be made by first providing a biocompatible component and a therapeutically active component; then physically associating the two components to form a combination product; and finally forming the combination product into a seed having a size and shape suitable for passing through the bore of a brachytherapy implantation needle (e.g., one having an interior diameter of less than about 2.7 millimeters (10 gauge)). Seeds can be formed into a suitable size and shape by any suitable method, e.g., molding, pressing, extruding, stamping, or chopping.

Brachytherapy seeds of the invention that are associated with a radiopaque marker can be made similarly with the addition of a step of associating the radiopaque marker with the seed. Brachytherapy seeds of the invention that include a sealed container housing a radioisotope can be made by at least partially coating the container with the biocompatible component and therapeutically active component.

Method for Administering a Therapeutically Active Component to a Target Tissue in a Subject

The brachytherapy seeds of the invention can be fashioned into a size and shape similar or identical to conventional radioactive brachytherapy seeds. Accordingly, the brachytherapy seeds of the invention can be implanted into a target tissue within a subject (e.g., a human patient or a non-human animal) by adapting known methods for implanting conventional radioactive brachytherapy seeds into a tissue. For example, the brachytherapy seeds of the present invention can be implanted using one or more implantation needles; Henschke, Scott, or Mick applicators; or a Royal Marsden gold grain gun (H. J. Hodt et al., British J. Radiology, pp. 419–421, 1952). A number of suitable implantation devices are described in, e.g., U.S. Pat. Nos. 2,269,963; 4,402,308; 5,860,909; and 6,007,474. Pharmacokinetics

The brachytherapy seeds of the invention can advantageously be used to selectively deliver a predetermined amount of a therapeutically active substance to a target tissue. For example, when a brachytherapy seed including a therapeutically active substance is implanted in a prostate, the therapeutically active substance will be released from the seed into the tissue surrounding the implantation site. The diffusion or release characteristics of the therapeutically active substance in relation to the target tissue, i.e., the pharmacokinetics of the substance, can be modulated by selecting appropriate biocompatible components included

within the seeds, and by varying the concentration of the therapeutically active substance in each seed.

In many applications, to treat a given target tissue with a therapeutic agent it is desirable (or even ideal) to fully saturate the target tissue with the therapeutic agent, while avoiding under- or over-dosing the target tissue. This can be achieved by implanting the brachytherapy seeds of the invention into a target tissue using a brachytherapy implantation device so that, e.g., a precise number of seeds can be implanted in precise locations within the target tissue. By previously calculating the rate of diffusion of the therapeutically active substance under experimental conditions (e.g., using tissue from animal models), an appropriate dosage can be delivered to the target tissue. Because use of brachytherapy implantation devices allows the brachytherapy seeds of the invention to be implanted in any number of different desired locations and/or patterns in a tissue, this method is advantageous over methods where a drug or drug impregnated matrix is simply placed on the surface of a tissue or manually inserted into a surgically dissected tissue.

Other Embodiments

While the above specification contains many specifics, these should not be construed as limitations on the scope of the invention, but rather as examples of preferred embodiments thereof. Many other variations are possible. For example, although the foregoing embodiments describe brachytherapy seeds having a single type of therapeutically active component and/or single type of radioisotope, brachytherapy seeds for use in the methods within the invention can also have a plurality of different therapeutically active agents and/or a plurality of different radioisotopes. Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.

What is claimed is:

1. A method for administering a therapeutically active component to a target tissue in a subject, the method comprising the steps of:

providing a brachytherapy seed comprising a non-metal biocompatible component, a therapeutically active component comprising a non-radioactive drug, and a radiopaque marker, said biocompatible component being (a) physically associated with a therapeutically active component and (b) in contact with said radiopaque marker, wherein said brachytherapy seed has a size and shape suitable for passing through the bore of a needle having an interior diameter of less than about 2.7 millimeters (10 gauge);

providing a brachytherapy implantation instrument comprising at least one brachytherapy implantation needle having a bore having an interior diameter of less than about 2.7 millimeters (10 gauge), and being adapted to accept the brachytherapy seed into the bore of the at least one brachytherapy implantation needle and deliver the accepted implantation device into a target tissue;

introducing the brachytherapy seed into the bore of the at least one implantation needle of the brachytherapy implantation instrument;

introducing at least a portion of the at least one brachytherapy implantation needle into a target tissue in the subject; and

actuating the brachytherapy implantation instrument such that the brachytherapy seed is delivered through the bore of the brachytherapy implantation needle into the target tissue.